THE GENUS *SELENARIOPSIS* MAPLESTONE, 1913 (BRYOZOA, ASCOPHORINA)

P. E. BOCK & P. L. COOK

BOCK, P. E. & COOK, P. L. 1996. The Genus *Selenariopsis* Maplestone, 1913 (Bryozoa, Ascophorina) *Records of the South Australian Museum* **29**(1): 23–31.

Lunulitiform colonies of *Selenariopsis* are a frequent component of the microfauna inhabiting the surface and upper layers of the deeper shelf sediments off the southern and eastern coasts of Australia. Colonies are anchored by rhizoids originating from special porous areas on the exposed basal walls. Although colonies are fragile, fragmented specimens are present as fossils in the clay-rich marine Tertiary sediments of Victoria and South Australia. Tertiary colonies include two taxa, *S. macgillivrayi* sp. nov. and *S. marginata* sp. nov., both of which are distinct from the Recent form, *S. gabrieli* Maplestone, 1913. Full descriptions and a key to all three species are given below.

P. E. Bock, Royal Melbourne Institute of Technology, 124 La Trobe St., Melbourne 3001, and P. L. Cook, Associate, Museum of Victoria, Swanston St., Melbourne 3000. Manuscript received 20 December 1995.

The distinctive 'sand fauna' species *Selenariopsis gabrieli* Maplestone, 1913 has been reported several times from the coasts of New South Wales, Western Australia and South Australia, as well as from Bass Strait. Colonies live in or upon the upper layers of sediment and have been reported previously from 54–366 m deep (see Cook & Chimonides 1981a, and Wass & Yoo 1983). Colonies are lunulitiform and live anchored by large basal rhizoids. *Selenariopsis* has been reported from the Tertiary of Victoria, as *?Lunulites angulopora* by MacGillivray (1895), and this record has usually been included in the synonymy of *S. gabrieli*, the Recent form (see Powell 1966; Cook & Chimonides 1981a). Examination of Recent specimens of *S. gabrieli*, and analysis of numerous Tertiary samples from Victoria and South Australia has revealed the presence of two additional species neither of which is *S. gabrieli*. One appears to be the *?Lunulites angulopora* of MacGillivray (1895), the other is described for the first time below.

MATERIALS AND METHODS

Abbreviations of institutions referred to in this paper are: MV, Museum of Victoria, Melbourne; AM, Australian Museum, Sydney; SAM, South Australian Museum, Adelaide. Specimens were coated with gold for scanning electron microscopy.

SYSTEMATICS

Order Cheilostomatida Busk, 1852

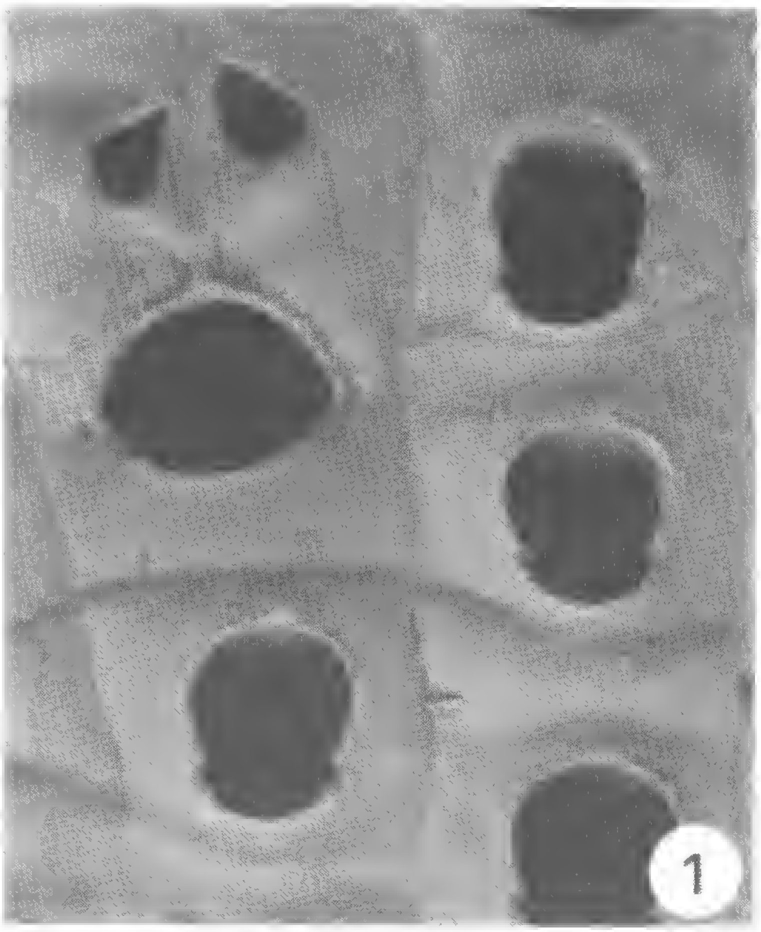
Suborder Ascophorina Levinsen, 1909

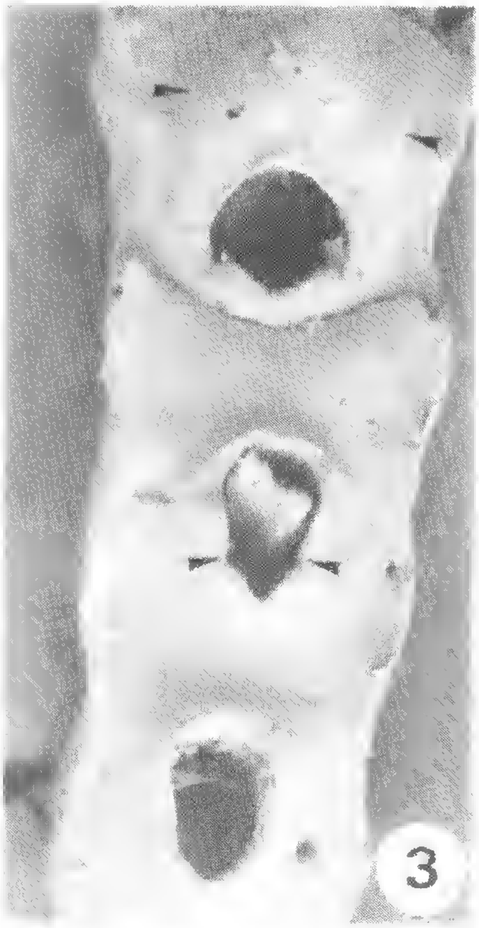
Super Family CATENICELLOIDEA Busk, 1852

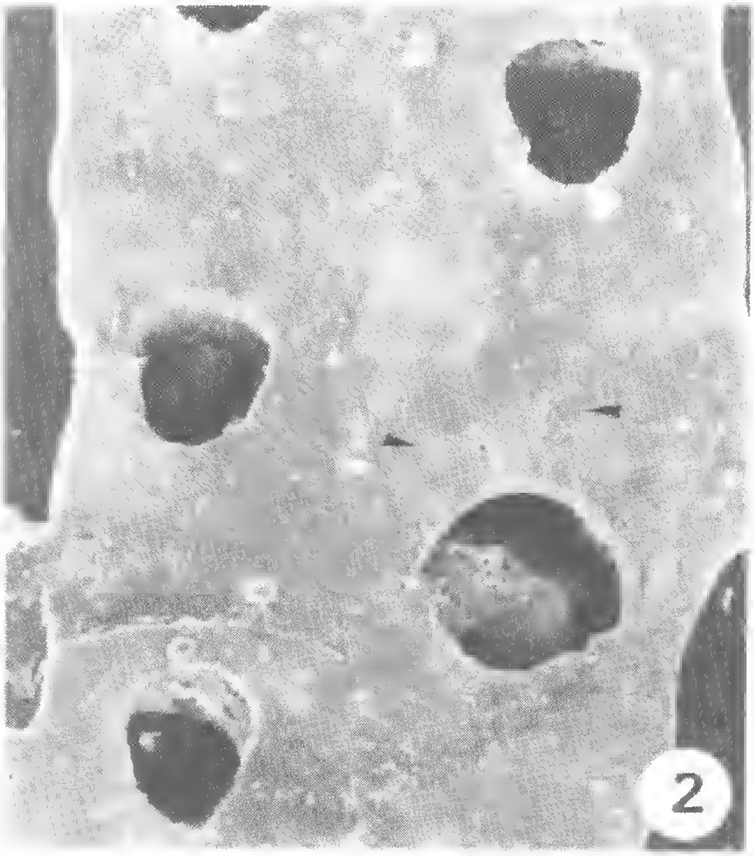
Family EURYSTOMELLIDAE Levinsen, 1909

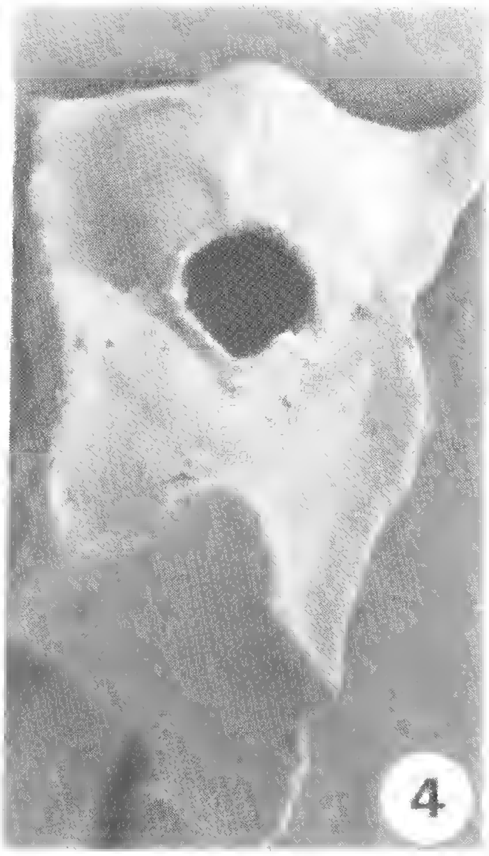
Cook and Chimonides (1981a) referred *Selenariopsis* to an informal grouping of genera, the Gymnocystidean Ascophora, based on the nature of the calcified frontal shield. Relatively few genera are known to have gymnocystidean ontogeny, and these are not closely related systematically to one another. Several gymnocystidean genera have been discussed by Gordon (1984, 1989), and referred to different superfamilies.

The affinities of the Eurystomellidae are somewhat problematical. *Eurystomella bilabiata* (Hincks) and *Selenariopsis gabrieli* Maplestone have completely non-porous, gymnocystidean frontal shields, the only areas of cryptocyst occurring as proximo-lateral embayments at the edges of the orifice, which appear to be associated with the hinging of the operculum (see Cook & Chimonides 1981a). *E. foraminigera* (Hincks) has, however, a shield with large, cuticle-covered, cryptocyst-bordered foramina (see Cook & Chimonides 1981a and Gordon 1984). The


1


3


2


4

ovicells of all three species are endozooidal, the brooding zooid having an enlarged, dimorphic orifice, which in *S. gabrieli* is closed by the operculum. The ovicell cavities are associated with a distal autozooid or kenozooid. The frontal ectooecium has one or more areas of cuticle–covered entooecium and a median suture. There are similarities in both frontal shield and ovicell structure with some members of the family Catenicellidae (see Banta & Wass 1979 and Wass & Banta 1981). Gordon (1984, 1989) has included the Eurystomellidae with the Catenicellidae in the superfamily Catenicelloidea.

Genus ***Selenariopsis*** Maplestone, 1913

Selenariopsis Maplestone, 1913: 359; Cook & Chimonides, 1981a: 114.

Australiana Powell, 1966: 19.

Diagnosis

Colonies lunulitiform, budded radially. Zooids with imperforate, gymnocystidean frontal shields and sinuate primary orifices. Basal walls with uncalcified windows and porous areas which are the origin of rhizoids in Recent colonies. Ovicells with dimorphic orifice, closed by the operculum, with paired entooecial areas frontally. Avicularia absent.

KEY TO SPECIES

1 – Orifices elongated, raised marginally. Ovicell fairly prominent, followed by an autozooid, with extensive, but faintly marked, paired entooecial areas. Basal porous areas usually very small .... *S. marginata* sp. nov.

– Orifices not raised marginally; basal porous areas larger 2

2 – Autozooid frontals oblong. Orifice with a subtriangular sinus. Ovicell depressed distally, followed by an autozooid. Small paired entooecial areas close to median suture. Basal windows very narrow .... *S. macgillivrayi* sp. nov.

– Autozooid frontals almost square. Orifice with a wide rounded sinus. Ovicell wide, immersed in a distal kenozooid with paired distal fenestrae. Basal windows oval .... *S. gabrieli* Maplestone

Selenariopsis gabrieli Maplestone, 1913
(Figs 1, 7)

Selenariopsis gabrieli Maplestone, 1913: 359, pl. 28, figs 6–10; Cook & Chimonides 1981a: 114, Figs 2D, 3, 4E, 5A–C, 9C; Wass & Yoo 1983: 337, Figs 44–46.

Australiana bifenestrata Powell, 1966: 20, pl. 1, figs 1–7, Fig. 1a–i; Cook 1979: pl. 1, figs 12d, e, Fig. 1F.

Material Examined

AM Gabo Island, Victoria, 366 m. MV Kimbla Stn 65D, Bass Strait, 207 m. Kimbla Stn 99, Bass Strait, 139 m. SLOPE Stn 19, off Eden, New South Wales, 520 m. Slope Stn 45, off Freycinet Peninsula, Tasmania, 800 m. Great Australian Bight Stn 030, 33°13'S, 128°29'E, 137 m.

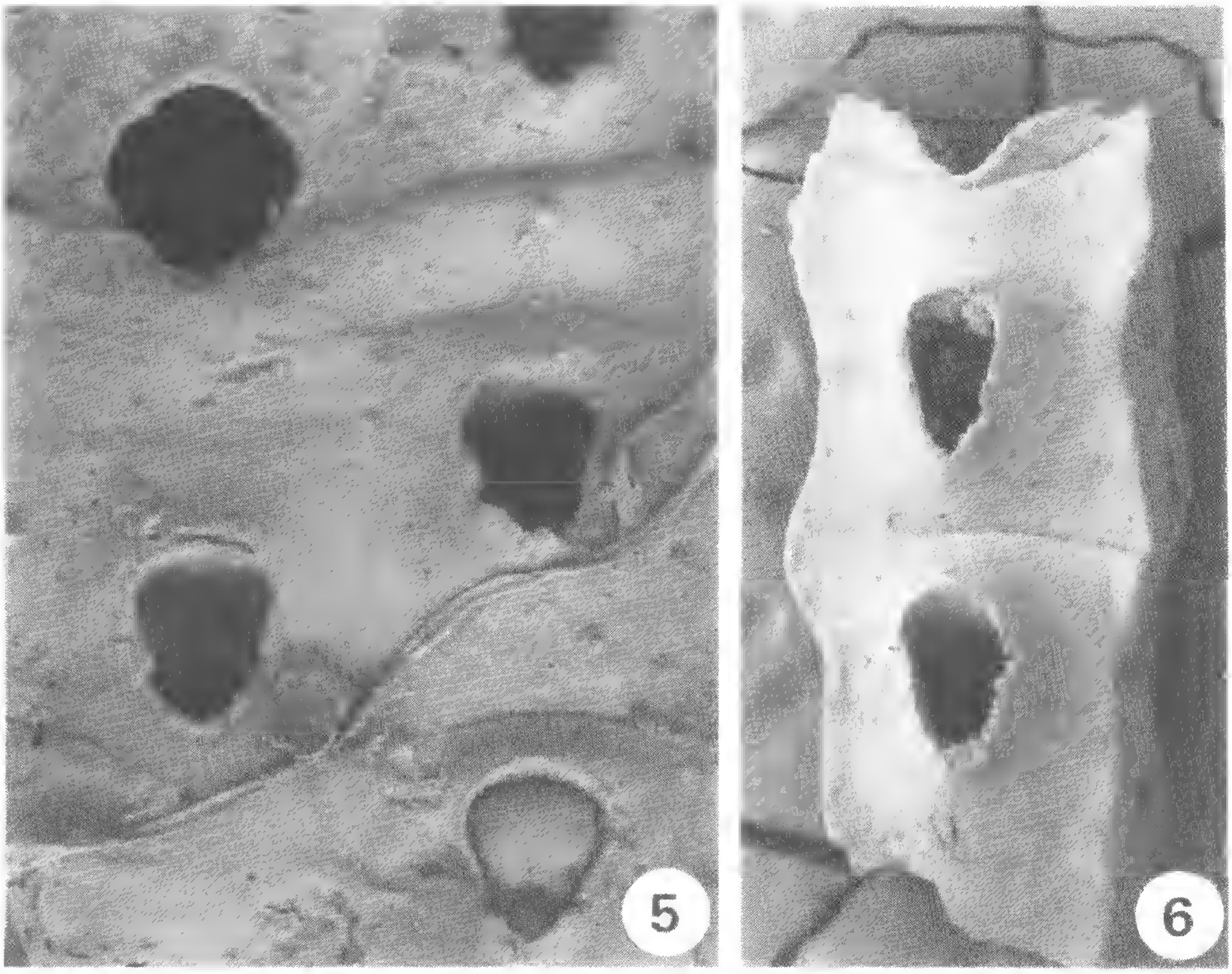
Description

Autozooid with short, almost square frontal shield, orifice nearly central with a short, rounded sinus marked by minute lateral embayments of cryptocyst. Brooding orifice wide, almost semicircular. Ovicell wide, not prominent, immersed in a distal kenozooid with large, paired, subtriangular entooecial fenestrae on its frontal surface. Basal autozooid windows oval or slightly narrower; those of brooding zooids are very large and subtriangular. The rhizoid windows are a narrow crescent, with a large proximal porous area surrounded by a raised rim. Pores are placed round the edge of the large, rounded to subrectangular area; the rhizoids are large.

Distribution

A. bifenestrata was described by Powell (1966) from Bulgo and from several other New South

◀ FIGURES 1–4. **1**, *Selenariopsis gabrieli* Maplestone, Kimbla Stn 99. Autozooids and one brooding zooid with paired distal kenozooidal frontal fenestrae; note 'growth lines', X118; **2**, *S. macgillivrayi* sp.nov., Princetown. Autozooids and one brooding zooid with inconspicuous distal ovicell with paired frontal areas (arrowed), X110; **3**,**4**, *S. marginata* sp.nov., Princetown; **3**, Brooding zooid with ovicell, frontal areas arrowed; and two autozooids, one showing proximo–lateral embayments (arrowed), and subtriangular sinus, X80; **4**, Brooding zooid with ovicell, X80.



FIGURES 5–6. **5**, *Selenariopsis macgillivrayi* sp.nov., Princetown. Autozooid orifices and one brooding zooid; note 'growth line', X110; **6**, *S. marginata* sp.nov., Princetown. Two autozooids showing raised orifices and lateral septular pores, X80.

Wales localities. The records given by Wass and Yoo (1983) extend from Western Australia, near Albany through the Bight to the western end of Bass Strait. The other records given above include one from the Great Australian Bight, and also extend from Bass Strait east to New South Wales, and south to Tasmania. Recorded depths now range from 54 to 800 m.

Remarks

Colonies may reach a diameter of more than 5 mm, and 3.50 mm in height, although the vertical dimension is variable, some colonies being fairly flattened, while others are strongly domed, as illustrated by Powell (1966). Rhizoids are 0.25 mm wide, and may reach more than 3 mm in length; even small colonies usually have several present. The ancestrula has an uncalcified frontal wall and a large, prominent basal pore plate giving rise to a rhizoid. Brooding zooids are scattered and do not appear before the fourth astogenetic generation. Frontally , the surface of colonies is smooth, even the ovicells hardly protruding. The morphology has been described in great detail by Powell (1966), and the mode of life and the associated fauna in one sample was discussed by Cook (1979). The early astogeny and relationships were described by Cook and Chimonides (1981a). *S. gabrieli* differs from its two fossil congeners in the shape of the orifice, and the structure and relationships of the ovicell.

***Selenariopsis macgillivrayi* sp. nov.**
(Figs 2, 5, 8)

?*Lunulites angulopora* MacGillivray, 1895: 46, pl. 8, fig. 1 (not *L. angulopora* Tenison Woods, 1880 = *Conescharellina angulopora*).

Material Examined

Holotype: MV P27625, Muddy Creek, Victoria, Miocene (see Powell 1966); also material from Cooriemungle, Balcombe Bay, Grices Creek, Princetown, Gellibrand Clay, Mount Martha, Victoria and Mount Schanck, South Australia (SAM P35472).

Description

Autozooids with almost oblong frontal shield, orifice placed in the distal half, slightly elongated, with a subtriangular sinus. The lateral embayments are very small, reduced to paired notches on the edge of the orifice. The brooding zooid orifice is wide and rounded. The ovicell is almost flat, and the next distal zooid is often crossed by a depressed groove in the calcification. The paired entooecial areas are small and not obvious; they are usually placed close to the median suture. The basal autozooid windows are very narrow, those of brooding zooids are more oval. The rhizoid windows are crescentic, with a large rounded proximal porous area within a raised rim. Pores are placed round the edge of the area.

Etymology

Named for P. H. MacGillivray, who first described the fossil specimens.

Distribution

S. macgillivrayi occurs in Miocene deposits from Mount Schanck in South Australia in the west to the east coast of Port Phillip Bay in Victoria.

Remarks

MacGillivray (1895) was doubtful that his specimen was the same species as that described as *Lunulites angulopora* by Tenison Woods (1880), but did not discuss his reasons. Two of Tenison Woods's species of 'Selenariadae', *L. crassa* and *L. angulopora*, are not lunulitiform and free-living, but belong to the genus *Conescharellina*. The name '*angulopora*' is not available for *Selenariopsis* and MacGillivray's species is therefore renamed here. MacGillivray gave no locality for his specimen, which consisted of two fragments only. As mentioned by Powell (1966) the specimens are labelled 'Muddy Creek'. MacGillivray considered that the basal rhizoid window and porous area was the zooid orifice, and that the orifices on the other side of the fragments were 'probably avicularian'. Without the advantage of having complete colonies for examination, the basal and frontal surfaces do look remarkably alike. Both have smooth calcification marked into rectangles by vertical zooid walls. The more oval basal windows and slightly worn orifices appear to be extremely similar, to superficial inspection, and it is easy to understand how MacGillivray made the wrong interpretation.

The specimens examined here are also all fragmentary, and are generally rare, although present at a large number of localities. More than 70 fragments, the largest of more than 50 zooids, are present in the sample from Princetown, and are accompanied by *S. marginata* sp. nov.

S. macgillivrayi differs from *S. gabrieli* in the more elongated shape of the orifice, and the slightly smaller and rounder basal porous areas. The principal difference is that the zooid distal to the ovicell is an autozooid, not a kenozooid, and the entooecial areas are placed close to the median suture, on the frontal surface of the ovicell. *S. macgillivrayi* differs from *S. marginata* sp. nov. in the size of zooids, and the shape and size of zooid orifices. The basal porous areas are larger and the basal windows narrower.

Selenariopsis marginata sp. nov.

(Figs 3, 4, 6, 9, 10)

Material Examined

Holotype: MV P140966, Princetown, Miocene.

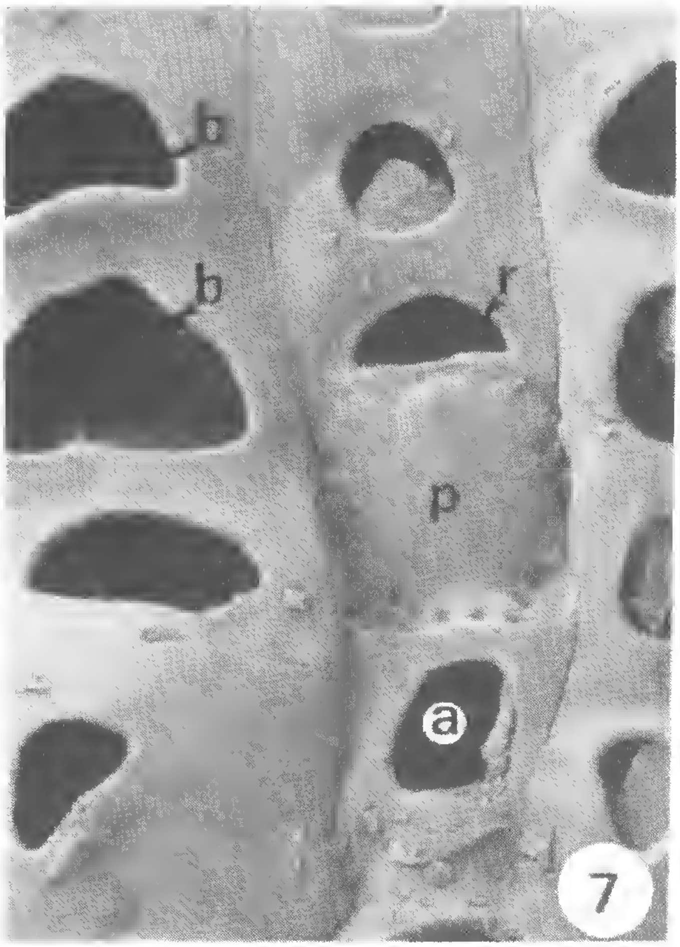
Paratype material: Princetown and Balcombe Bay, Victoria, Miocene (SAM P35471).

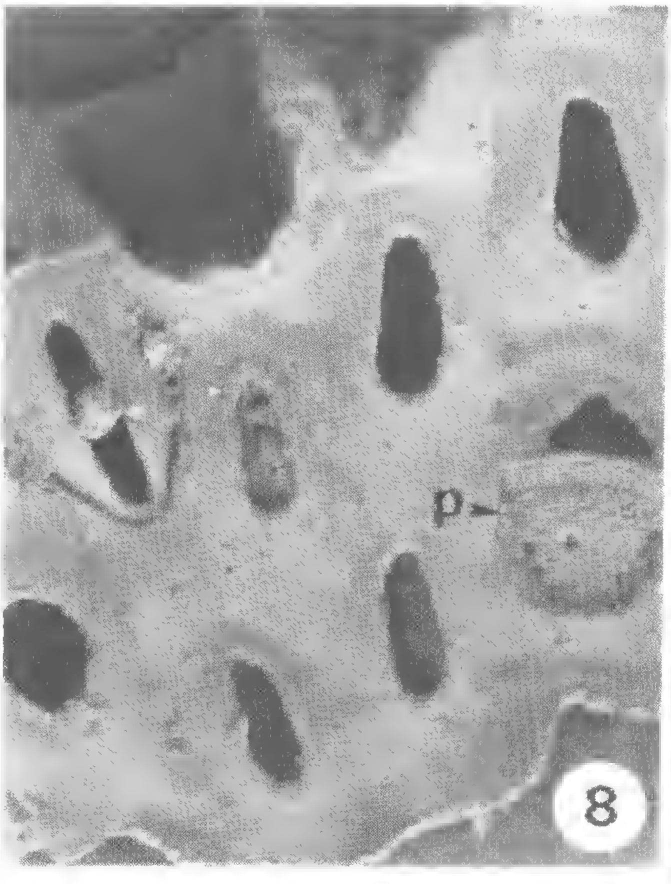
Description

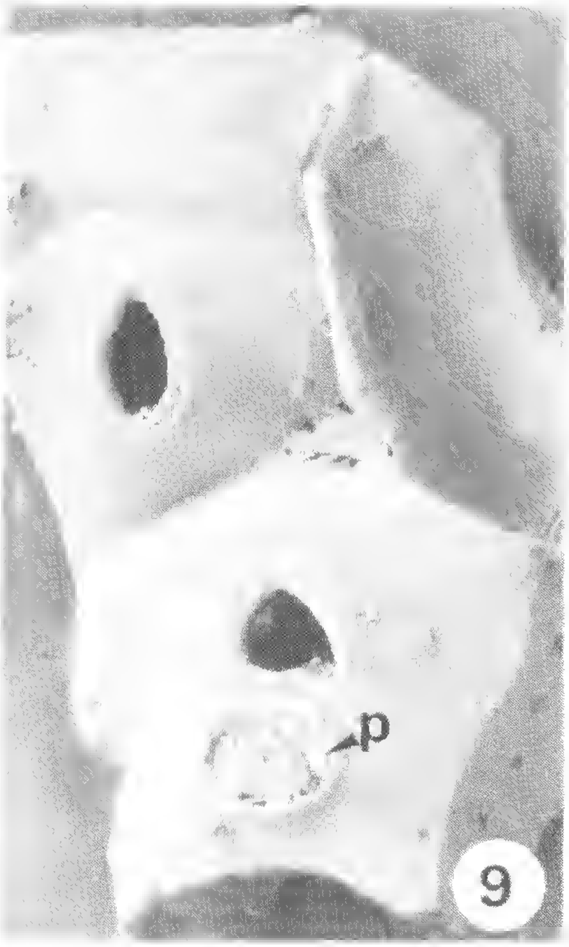
Autozooid frontal shields large, short and wide, often almost square. Orifices nearly central, large, marginally raised, elongated, with a subtriangular sinus and minute lateral embayments only visible in well preserved specimens. The brooding zooid orifice is wide and rounded with a subtriangular sinus. The ovicell is more prominent than that of *S. macgillivrayi*, and distinctly narrower than both the brooding zooid and distal autozooid. The frontal areas are often not obvious, but when present, are placed well away from the median suture on the ovicell frontal wall. The basal windows of autozooids and brooding zooids are oval or nearly circular. The basal rhizoid windows are usually small, and are sometimes more subtriangular than crescentic; the porous area is also very small, sometimes minute, and is circular, with a raised rim and scattered pores.

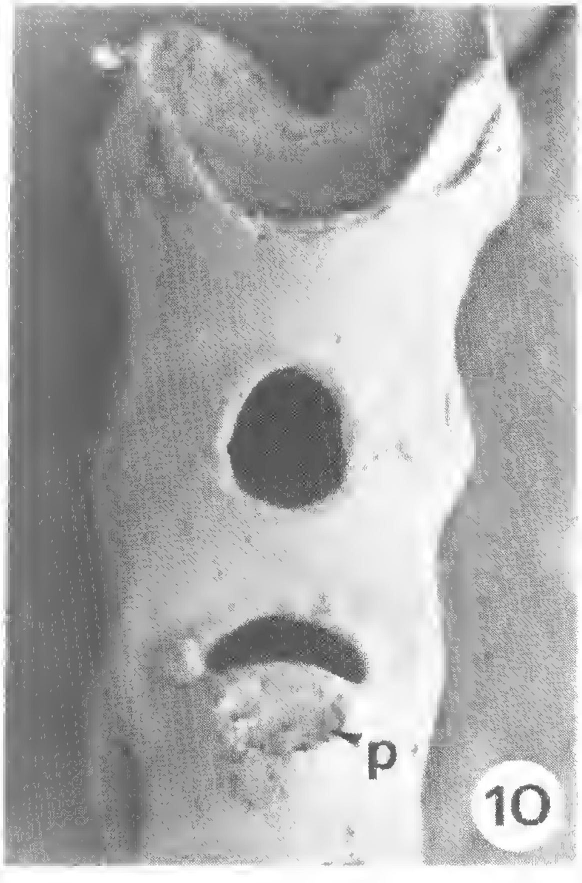
Etymology

Marginatus. L., enclosed with a border, referring to the raised rims of the zooidal orifices.


b
b
r
p
a
7


p
8


p
9


p
10

Distribution

Miocene of Victoria.

Remarks

S. marginata is represented by fewer than 60 fragments, the largest of only 8 zooids, but its characters are distinct and consistent. The dimensions of zooids appear to be generally much larger than those of the other two species, at the inferred equivalent astogenetic stage.

S. marginata is distinguished from both *S. gabrieli* and *S. macgillivrayi*, with which last it often occurs, by the raised margins of the elongated orifices. These may be so prominent that they make the colony surface appear to be rugose. The other obvious difference is the small size of the basal porous areas. The ovicell is less depressed than that of *S. macgillivrayi*, which it resembles in having a distal autozooid, unlike the kenozooid of *S. gabrieli*.

Discussion

Although no complete colony of *Selenariopsis* has been preserved as a fossil, it is remarkable that such delicate species have been found in fragments large enough to be recognizable, and distinguishable from each other. The slight curvature and the budding pattern of the fragments allow the inference that they had a lunulitiform shape when complete. The occurrence of the distinctive windows and porous areas on the basal side of the fossils allows the inference that they, too, developed rhizoids in life, and lived in a similar manner to *S. gabrieli*. The larger fragments of *S. macgillivrayi* show ridges frontally between zooid generations and 'growth lines' in the calcification of the frontal shields (Fig. 5). These also occur in colonies of *S. gabrieli*, where they appear to be related to episodes of repair, and of 'seasonal growth', and to rapid calcification of the frontal membranous wall of zooid buds (Fig. 1).

The differences among the three species of *Selenariopsis* are small, but in several characters, the states are distinct and consistently correlated (Table 1). *S. gabrieli* resembles *S. macgillivrayi* in many ways and may be a direct descendant. *S. marginata* differs from both species in zooid size and the raised margins of the elongated autozooid orifices, as well as in the very small basal porous areas.

It is interesting that the Recent species, *S. gabrieli*, exhibits two features which indicate a closer relationship with the genus *Eurystomella* than with its fossil congeners. The cryptocyst embayments at the edge of the orifice, although small in *S. gabrieli*, are distinct; in the fossil species they are much smaller, and can often hardly be distinguished. Further, in *S. gabrieli* and all species of *Eurystomella*, the kenozooid which completely envelops the distal end of the ovicell capsule also bears the entooecial window or fenestrae on its frontal wall.

In *S. macgillivrayi* and *S. marginata* the entooecial areas are part of the frontal wall of the ovicell capsule, not the distal autozooid, which surrounds the capsule on the basal side only. A

TABLE 1. Measurements in mm of species of *Selenariopsis*. Lz, lz, length and width of autozooid; Lo, lo, length and width of orifice; L bro, l bro, length and width of brooding zooid orifice; Lov, lov, length and width of ovicell; Lbw, lbw, length and width of basal window; Lrw, lrw, length and width of rhizoid window; Lpa, lpa, length and width of porous area.

Character	*S. gabrieli*	*S. macgillivrayi*	*S. marginata*
Lz	0.30–0.44	0.30–0.45	0.37–0.66
lz	0.25–0.40	0.25–0.40	0.36–0.48
Lo	0.11–0.16	0.13–0.18	0.18–0.25
lo	0.10–0.12	0.10–0.13	0.12–0.16
L bro	0.11–0.13	0.16–0.18	0.15–0.17
l bro	0.16–0.18	0.16–0.19	0.14–0.16
Lov	0.08–0.10	0.18–0.23	0.25–0.30
lov	0.21–0.24	0.22–0.32	0.30–0.40
Lbw	0.16–0.22	0.20–0.21	0.17–0.24
lbw	0.12–0.15	0.02–0.06	0.12–0.14
Lrw	0.10–0.12	0.08–0.09	0.08–0.10
lrw	0.20–0.23	0.14–0.18	0.10–0.16
Lpa	0.18–0.25	0.20–0.25	0.08–0.16
lpa	0.16–0.25	0.17–0.25	0.08–0.18

◀ FIGURES 7–10. 7, *Selenariopsis gabrieli* Maplestonc, Kimbla Stn 99. Basal walls, showing uncalcified windows of brooding zooids and ovicells (*b*), autozooids (*a*), and one rhizoid window (*r*). Large, subrectangular porous area with marginal pores (*p*), X100; **8**, *S. macgillivrayi* sp.nov., Princetown. Narrow basal windows of autozooids and one rhizoid window with proximal porous area (*p*), X80; **9–10**, *S. marginata* sp.nov., Princetown. Distal autozooid, and proximal rhizoid basal windows; note small, circular porous areas (*p*). Fig. 9, X80; Fig. 10, X100.

parallel series of differing relationships in time, among the brooding zooids, ovicells and distal zooids occurs in species of the Australian Tertiary–to–Recent genus *Quadriscutella* (see Bock & Cook 1993).

The cuticle–covered basal window of each zooid of *Selenariopsis* has a parallel in the ascophoran genera *Chiastosella* and *Didymosella*. Both these genera have a wide Tertiary–to–Recent geographic range, and are particularly well represented in Australasia. Although many species have a semi-repent, unilaminar colony form, none is lunulitiform. Powell (1967:285) noted that colonies of *Chiastosella splendida* were attached by basal rhizoids, but the only description of the basal windows was given by Waters (1881:340) in fossil specimens of *C. conservata* from Victoria. The basal windows of *Didymosella larvalis* were described by Cook and Chimonides (1981b); they do not give rise to any rhizoids, but in *D. pluma*, a South American species, they may be produced into long, hollow, extrazooidal calcified processes.

Many of the reports of *S. gabrieli* have been from fairly deep shelf, and upper slope depths, the two deepest among the samples listed above being from 520 and 800 m. The associated bryozoans from these samples include many with cellulariiform, erect colonies, all anchored by rhizoids (see Bock & Cook in press). Species found in association with *S. gabrieli* at the shallower end of the depth range have been discussed by Cook (1979), and included forms of *Melicerita*, *Sphaeropora* and *Conescharellina*. These too, are anchored by rhizoids. Specimens of these three genera are robust, and are often preserved entire as fossils as well as occurring in Recent sediments. Some colonies of *Conescharellina*, and of the free–living lunulitiform genera *Lunulites*, *Lunularia* and *Selenaria* all occur in the Princetown samples. There is, however, no correlation of numerous sand fauna taxa in association with the two fossil species of *Selenariopsis*, and certainly no suggestion that the assemblage was from very deep water.

ACKNOWLEDGMENTS

We should like to thank the Museum of Victoria and Australian Museum for access to collections, and D. McDonald for help in preparation of this paper.

APPENDIX

Details of Tertiary Localities in Victoria and South Australia.

Balcombe Bay: Also known as **Fossil Beach**, **Mornington**, **Mount Martha** and possibly **'Schnapper Point'** (MacGillivray); on coast of Port Phillip Bay, about 3 km south of Mornington, Victoria. Lat. 38°14.5'S, Long. 145°01.7'E. Fyansford Clay. Age: Balcombian; Middle Miocene, (Langhian).

Cooriemungle area: Road cuttings about 18 km north of Princetown. Lat. 38°32.4'S, Long. 143°08.1'E. Gellibrand Marl. Age: Balcombian.

Gellibrand. This locality was mentioned by MacGillivray (1895), and is in the same area as **Princetown** (see below).

Grices Creek: Also known as **Gunyong Creek**; on coast of Port Phillip Bay, about 8 km north of Mornington, Victoria. Lat. 38°11.9'S, Long. 145°03.9'E. Fyansford Clay. Age: Balcombian (some material may be Bairnsdalian); Middle Miocene, (Langhian).

Mount Schanck: Limestone quarry about 1 km west of Mount Schanck, about 15 km south of Mount Gambier, South Australia. Lat. 37°57'S, Long. 140°43.2'E. Gambier Limestone. Age: Longfordian; Early Miocene.

Muddy Creek: Clifton Bank, Muddy Creek, 8 km west of Hamilton, Victoria. Lat. 37°44.6'S, Long. 141°56.4'E, Muddy Creek Marl (= Gellibrand Marl). Age: Balcombian.

Princetown (*Gigantocypraea* locality): Coastal section, about 2 km west of Princetown, Victoria. Lat. 38°41.9'S, Long. 143°08.3'E, Gellibrand Marl. Age: Balcombian.

REFERENCES

BANTA, W. C. & WASS, R. E. 1979. Catenicellid cheilostome Bryozoa. 1. Frontal walls. *Australian Journal of Zoology, Supplementary Series* **68**: 1–70.

BOCK, P. E. & COOK, P. L. 1993. *Quadriscutella* gen. nov., (Bryozoa: Cheilostomata), from the Tertiary and Recent of Victoria and South Australia. *Alcheringa* **17**: 159–171.

BOCK, P. E. & COOK, P. L. In press. New genera and species of uniserial Cheilostomatida (Bryozoa) from the continental shelf and slope of southeastern Australia. *Proceedings of the Royal Society of Victoria*.

BUSK, G. 1852. Catalogue of the Marine Polyzoa in the Collection of the British Museum. Part 1. Cheilostomata (part). Trustees of the British Museum (Natural History): London pp. i–viii, 1–54, i–vii.

COOK, P. L.1979. Mode of life of small, rooted "sand fauna" colonies of Bryozoa. Pp. 269–281 *in* 'Advances in Bryozoology', Systematic Association special volume 13. Ed. G. P. Larwood & M. B. Abbott. Academic Press, London.

COOK, P. L. & CHIMONIDES, P. J. 1981a. Morphology and systematics of some rooted cheilostome Bryozoa. *Journal of Natural History* **15**: 97–134.

COOK, P. L. & CHIMONIDES, P. J. 1981b. Morphology and systematics of some interior–walled cheilostome Bryozoa. *Bulletin of the British Museum (Natural History)*, Zoology **41**(2): 53–89.

GORDON, D. P. 1984. The marine fauna of New Zealand: Bryozoa: Gymnolaemata from the Kermadec Ridge. *New Zealand Oceanographic Institute Memoir* **91**: 1–198.

GORDON, D. P. 1989. The marine fauna of New Zealand: Bryozoa: Gymnolaemata (Cheilostomida Ascophorina) from the western South Island Continental Shelf and Slope. *New Zealand Oceanographic Institute Memoir* **95**: 9–158.

LEVINSEN, G. M. R. 1909. 'Morphological and systematic studies on the cheilostomatous Bryozoa'. Nationale Forfatteres Forlag: Copenhagen.

MACGILLIVRAY, P. H. 1895. A monograph of the Tertiary Polyzoa of Victoria. *Transactions of the Royal Society of Victoria* **4**: 1–166.

MAPLESTONE, C. M. 1913. New or little-known Polyzoa. *Proceedings of the Royal Society of Victoria* n.s. **25**: 357–362.

POWELL, N. A. 1966. Studies on Polyzoa (Bryozoa) from the Endeavour Expedition 1909–1914. 1. A new lunulitiform polyzoan (Ascophora) from south-east Australia. *Records of the Australian Museum* **27**: 17–26.

POWELL, N. A. 1967. Polyzoa (Bryozoa) – Ascophora – from North New Zealand. *Discovery Reports* **34**: 199–394.

TENISON WOODS, J. E. 1880. On some Recent fossil species of Australian Selenariadae (Polyzoa). *Transactions of the Royal Society of South Australia* **3**: 1–12.

WASS, R. E. & BANTA, W. C. 1981. Catenicellid cheilostome Bryozoa II. Introduction to ovicell complexes. *Australian Journal of Zoology* **29**: 365–400.

WASS, R. E. & YOO, J. J. 1983. Cheilostome Bryozoa from the southern Australian continental shelf. *Australian Journal of Marine and Freshwater Research*. **34**: 303–354.

WATERS, A. W. 1881. On Fossil Chilostomatous Bryozoa from South-west Victoria, Australia. *Quarterly Journal of the Geological Society* **37**: 309–347.